

Interactive comment on “Mercury anomalies across the Palaeocene-Eocene Thermal Maximum” by Morgan T. Jones et al.

Anonymous Referee #2

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GENERAL COMMENTS

This paper investigates Hg concentrations and Hg/TOC ratios in 6 continental shelf sections that span the PETM. The presence of Hg anomalies and the architecture of the Hg and Hg/TOC curves varies substantially among sites. The authors attribute these variations primarily to site location: sites closer the NAIP contain Hg anomalies while sites that are more distant do not. Where anomalies are present, they appear prior to the onset of the CIE and/or during the recovery phase. An exception is Svalbard, where there is also a sustained anomaly during the body of the CIE. The authors interpret the presence of Hg anomalies prior to the onset of the CIE as evidence that the NAIP triggered the initial warming during the PETM. They also suggest that more localized deposition of Hg is consistent with substantial Hg release by submarine hydrothermal

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vents.

Overall, this is a well-written and thoughtful paper that presents a large data set relevant to unravelling the relationship between the NAIP and the PETM. One particular strength of this paper is its relatively detailed explanations of some of the uncertainties regarding the use of Hg/TOC curves as proxies for volcanism (in general) and site-specific uncertainties regarding the interpretation of the Hg/TOC records presented in this study. In my view, there has not been enough critical evaluation of the potential problems with applying Hg or Hg/TOC as a proxy for LIP volcanism in much of the recent literature.

That said, despite the detailed articulation of such uncertainties, the authors largely discount the influence of potentially complicating factors (e.g. influence of oil/gas migration, dissolution, weathering, diagenesis) in their interpretation of the PETM Hg and Hg/TOC records. I think the paper would be strengthened by giving greater consideration to the possibility that anomalies in some of these sections may not directly record volcanism. Thus, the authors could use this data set not only to explore the role of the NAIP in triggering the PETM, but also to emphasize the complexities associated with using Hg/TOC as a proxy for volcanism. To be clear, I am not suggesting fundamentally changing the conclusions of the paper, but instead giving more weight to alternative explanations for some of the Hg anomalies (particularly in the Grane Field and at the Dababiya locality).

SPECIFIC COMMENTS

-The extraordinarily high Hg concentrations in the Grane Field section are certainly worthy of attention, but difficult to interpret due to the potential effects of oil and gas seepage. Despite the possible effects of hydrocarbon migration, the authors conclude that high Hg concentrations before/after the CIE are likely due to Hg release by hydrothermal vent complexes associated with the NAIP. They base this conclusion on two lines of reasoning: 1) sediments before/after the CIE have higher Hg concentra-

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tions (by orders of magnitude) than the oil sands lower in the section, and 2) there are no known processes that can decouple Hg and organic carbon in hydrocarbon systems. However, as far as I'm aware, there is very little research about Hg reservoirs in hydrocarbon systems or Hg loss/gain during hydrocarbon maturation/migration. Thus, it seems premature to discount the role of hydrocarbon systems in generating these unusual values.

-The evidence for dissolution/weathering during the body of the CIE at the Dababiya, Egypt locale makes interpretation of the Hg record difficult. It is not clear on what basis the authors suggest that it is "unlikely" that the Hg/TOC anomaly at Dababiya is purely a product of diagenetic and weathering processes. Since "the effects of such processes on Hg/TOC ratios are poorly understood," wouldn't it be prudent to reserve judgement?

ADDITIONAL CITATIONS

The authors may want to incorporate findings from a recent paper that investigated the Hg isotopic composition of PETM and Eocene sediments from Lomonosov Ridge in the Arctic (Gleason et al., 2017, Sources and cycling to mercury in the paleo Arctic Ocean from Hg stable isotope variations in Eocene and Quaternary sediments: *Geochimica and Cosmochimica Acta* 197:245-262.). In short, this paper found that sediment from the PETM had a Hg isotopic composition consistent with that of Holocene sediments from the Arctic Ocean. This supports the conclusion that there was no large perturbation to the Hg cycle at this locality during the PETM.

LINE COMMENTS

Page 3, line 4: consider "temporal association" instead of "strong positive correlation"

page 3, lines 13-14: Although there is a need for "a well-tested and uniquely volcanic tracer in sedimentary rocks" – Hg anomalies are not unique tracers of volcanism. Hg anomalies could theoretically be generated through many different processes that re-

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lease Hg – wildfires, permafrost thawing, meteorite impacts, etc. This sentence seems to foreshadow the Hg/TOC ratios as a uniquely volcanic tracer – which gives the wrong impression.

Page 3, line 19: Normalizing to TOC accounts for changes in Hg due to changes in the drawdown of organic carbon; it doesn't necessarily account for changes in sediment accumulation rate.

Page 3, lines 20-21: - "proposed" instead of "reported"

Page 3, lines 23-24: Rather than say "therefore, this method is an important proxy," consider, "therefore, we use this method as proxy" for volcanism. Given the potential for mercury anomalies to reflect processes/sources other than volcanism (as acknowledged in the paper and detailed above), I would be more careful with language here.

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